

Ultra-Thin Ply Formable Material from Reusable Short Carbon Fiber Composites, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

This project develops an ultra-thin and formable prepreg material from reusable short carbon fiber composites (CFC), including process and material development, test panel fabrication and mechanical performance evaluation. Key to superior performance of ultra-thin ply materials is the ability to fabricate high fiber volume and uniform fiber distribution prepreg with low void content and layer thicknesses $\leq 20\mu\text{m}$. Our prepreg is made from short, aligned carbon fiber (CF) sheets and polymer film impregnation. We have demonstrated successful fabrication of 30gsm areal weight fabric material and recently proved ultra-thin ply prepreg impregnation with a low areal weight polymer film. The process is unique as it is not relying on spreading of large fiber tows but assembles individual short fibers creating better control of fiber content and thickness uniformity. The materials can be processed using conventional autoclave with mechanical properties equivalent to continuous CFC.

Key advantages of short CF thin-ply material compared to traditional continuous prepreg are the lower variability of the microstructure, the ability of in-plane stretching of short CFCs, the ability to hybridize at the fiber level and to reclaim the CF material for fabrication of new high-performance parts or as feedstock for additive manufacturing processes. The Phase I will demonstrate high-quality thin-ply uni and QI prepreps made from short CFs and a potential Phase II will consider evaluation of the multi-functional aspect of the material including hybridization, improved processability and recovery of short CFCs.

Anticipated Benefits

NASA has shown interest in applying thin-ply technology in various programs. The approach has the potential to reduce cost by 25% and weight by 30 percent compared to existing aluminum-lithium propellant tanks. Minimum weight solutions and the potential for material reuse with thin-ply are critical for deep-space habitation structures. The thin-ply technology also allows minimum gauge and hybrid designs for space suits optimizing mass efficiency.

The general approach and specific technologies developed in this STTR can also be applied to other military platforms and commercial applications (aerospace, automotive, wind etc). These applications may require additional material testing and R&D to meet certifications and particular application requirements.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Composites Automation, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

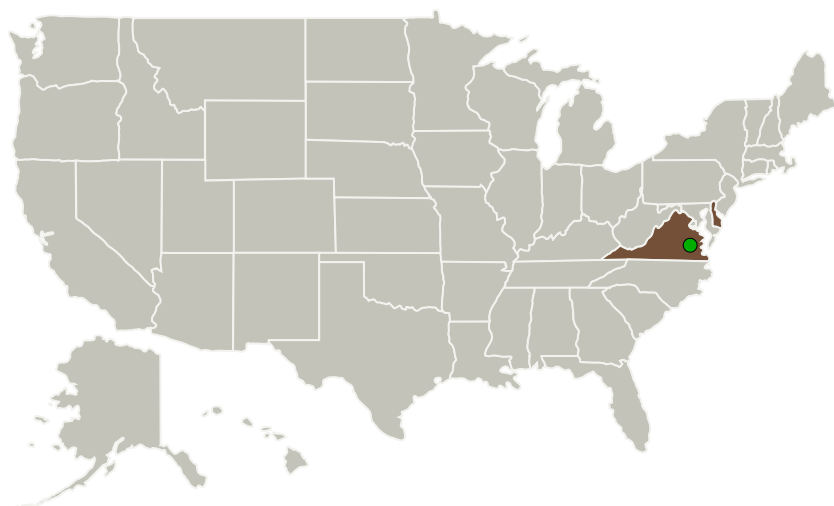
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Composites Automation, LLC	Lead Organization	Industry	Newark, Delaware
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
University of Delaware	Supporting Organization	Academia	Newark, Delaware

Primary U.S. Work Locations

Delaware	Virginia
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Project Transitions

July 2018: Project Start

August 2019: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140135>)

TechPort

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For more information and an accessible alternative, please visit:
<https://techport.nasa.gov/view/94786>

Project Management (cont.)

Program Manager:

Carlos Torrez

Principal Investigator:

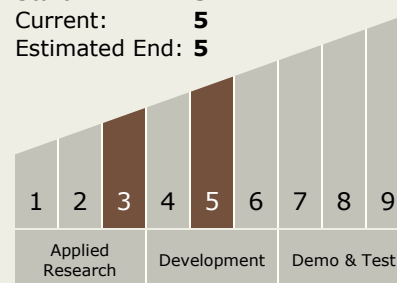
Roger Crane

Technology Maturity (TRL)

Start: 3

Current: 5

Estimated End: 5



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - TX12.1 Materials
 - TX12.1.1 Lightweight Structural Materials

Target Destinations

Earth, The Moon, Mars

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Images

Briefing Chart Image

Ultra-Thin Ply Formable Material
from Reusable Short Carbon Fiber
Composites, Phase I
(<https://techport.nasa.gov/image/126658>)

Final Summary Chart Image

Ultra-Thin Ply Formable Material
from Reusable Short Carbon Fiber
Composites, Phase I
(<https://techport.nasa.gov/image/125956>)